


Today's Class: **NASA Visible & Infrared Telescopes**

- Read about at Hubble and James Webb telescopes in Section 6.3 of *Cosmic Perspective*.
- Homework #3 due on Monday.



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Space in the News: **Astronauts to film skin care product in Space**  
Presented by Matt Lussier

<https://www.space.com/estee-lauder-skincare-filming-on-space-station.html>

- Astronauts will film Estée Lauder skincare serum on International Space Station.
- “So U.S. industry innovation and ingenuity can accelerate a thriving commercial economy in low-Earth orbit,”-NASA
- Important note: Not the first time, Chicken sandwiches, milk, pepsi have also made it to Space.
- NASA says it plans to dedicate up to 5% of astronaut time to commerce or business activities. Ninety hours of crew time will be available annually and 175 kilograms will be permitted for commercial purposes. (Par. 7 abc news, <https://abcnews.go.com/Politics/estee-lauder-pays-nasa-17500-hour-pictures-night/story?id=73101290>)
- \$17,500/hour to NASA, worth it? (Par. 3, abc news )

**Question:** If you were one of the world's highest trained astronauts, how would you feel about using 5% of your time in Space to film commercial products?



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What we've learned so far about Space Telescopes

- **Astronomical Imaging**
  - Colors
  - What do we learn from images?
- **Spectroscopy**
  - Design of spectrographs
  - What do we learn from spectra?

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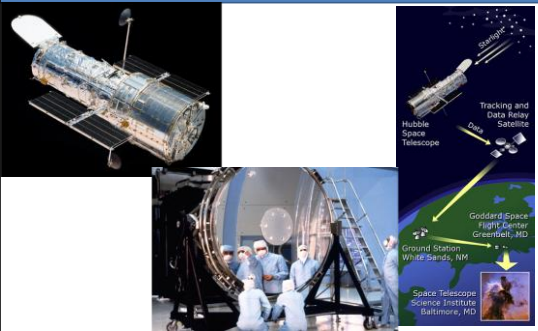
Today's Class

- The Hubble Space Telescope (HST) – visible and uv
- The James Webb Space Telescope (JWST) – near IR

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The Hubble Space Telescope



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Gallery of HST Images



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## The James Webb Space Telescope (JWST)

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## JAMES WEBB

JWST was formerly known as the "Next Generation Space Telescope" (NGST); it was renamed in Sept 2002 after a former NASA administrator, James Webb.

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## The James Webb Space Telescope (JWST)

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## The James Webb Space Telescope (JWST)

**iW Infrared**

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## The James Webb Space Telescope (JWST)

**iW Infrared**

**6.5**  
meter primary mirror

Mirrors designed & built by  
**Ball** Aerospace & Technologies Corp.  
here in Boulder!

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## The James Webb Space Telescope (JWST)


**iW Infrared**

Hubble's primary mirror **6.5** meter primary mirror

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## The James Webb Space Telescope (JWST)



**Infrared**

Hubble's primary mirror

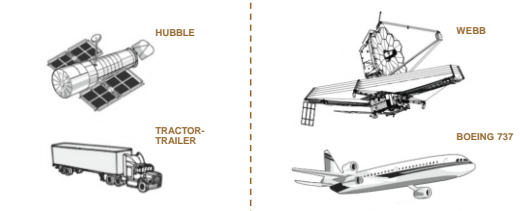
**6.5** meter primary mirror

**2022** LAUNCH DATE

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## How Big is JWST?



HUBBLE

TRACTOR-TRAILER

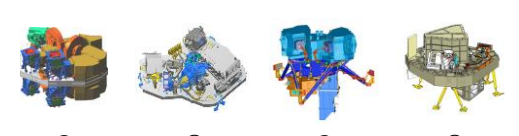
WEBB

BOEING 737

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## Four Main Science Instruments



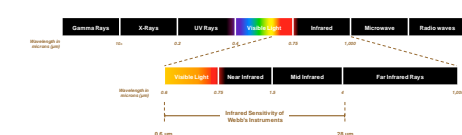
- 1 Near Infrared Camera (NIRC2)
- 2 Near Infrared Spectrograph (NIRSpec)
- 3 Mid-Infrared Instrument (MIRI)
- 4 Fine Guidance Sensor/ Near Infrared Imager & Slitless Spectrograph (FGS-NIRISS)

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## Infrared Range of Wavelengths

Webb's instruments will be designed to work primarily in the infrared range of the electromagnetic spectrum, with some capability in the visible range. It will be sensitive to light from 0.6 (orange) to 28 micrometers ( $\mu\text{m}$ ) in wavelength.



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## Four Main Science Themes

- 1 THE END OF THE DARK AGES: FIRSTLIGHT AND REIONIZATION
- 2 THE ASSEMBLY OF GALAXIES
- 3 THE BIRTH OF STARS AND PROTOPLANETARY SYSTEMS
- 4 PLANETARY SYSTEMS AND THE SEARCH FOR LIFE



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## The Launch of JWST

Arianespace's ELA-3 launch complex near Kourou, French Guiana



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## JWST Orbit

- Webb must be very cold
- Shielded from the heat of the Sun  
AND the Earth
- Solution: L2 (Lagrange point)

**THE L2 LAGRANGE POINT**  
Lagrange Points provide a stable configuration in which three bodies can orbit each other yet stay in the same position relative to each other.

JWST now scheduled for launch in Spring 2022

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## Class Exercise

Unlike the Hubble Space Telescope, JWST cannot be serviced in space. Why do you think astronaut-service missions were not included in the JWST design?

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## Deployment of JWST

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THE JAMES WEBB SPACE TELESCOPE

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